Volume 2, No. 4, April 2011
Journal of Global Research in Computer Science
ISSN-2229-371X
RESEARCH PAPER
Available Online at www.jgrcs.info

AGENT BASED E-HEALTH CARE INFORMATION SYSTEM

Arijit Das*, Sougata Khatua, Zhang Yuheng and N. Ch. S. N. Iyengar

School of Computing Science and Engineering, VIT University, Vellore, Tamil Nadu, India
arijitdasmid@yahoo.com* sougatakhatua@yahoo.com yuer.zhang1987@gmail.com nchsniyengar48@gmail.com

Abstract: The increasing level of patients demand across the world obliges governments to face health services in a more flexible and uniform manner. So it is better to building an agent-based information system's platform in order to grant home care services close to the patient's needs. The Agent computing in a network of workstations is powerful paradigm for building distributed applications. The e-health care is new kinds of health service and it is very popular at this time. Our objective of work describes the design and implementation a system that enhance the capability of small e-health care to uninterrupted service as per the patient demand. In this system all the transaction of data are processed by Patient Agents (PA), Doctor Agents (DA) and Controller Agent (CA). The user uses the Patient Agent (PA) to connect with the controlling server of the e-health care system. The Controller Agent (CA) is control the demand of the patients as well as activity of the doctors. When the doctor wants to check-up the patient then he/she connects with the Doctor Agent (DA). Using the Doctor Agent (DA), every doctor prescribed some medicine to the patient about the query and if required then refer the patient to another doctor.

Keywords: Patient Agent, Doctor Agent, Controller Agent

INTRODUCTION

Electronic Health Care, or e-Health Care, for paperless management of all activities within large healthcare establishments, promises much in speeding up the typical operation of healthcare in medical centers and hospitals.

A typical e-health care system can consist of many components and subsystems, such as for patient, creating an account (registration), search department, search doctor, make appointments after filling all the details & put the query ,and pay money. For the doctor check the appointment list, check-up the patient, prescribed some medicine and if required then refer the patient another doctor.

Multi-agent systems have been contributing to the development of the theory and the practice of high-speed, mission-critical, decentralized information systems where mutual interdependencies, dynamic environments, uncertainty, and sophisticated control play a singular role [5]. Multi-agent systems can be considered a suitable technology for the development of healthcare applications where the use of loosely coupled and heterogeneous components, the dynamic and distributed management of data and the remote collaboration among users are often considered the most relevant requirements [3].

Multi-agent systems are one of the most interesting areas in software research and they have been importantly contributing to the development of the theory and the practice of complex distributed systems. In particular, they have shown their potential to meet critical needs in high-speed, mission-critical, content-rich, distributed information systems where mutual interdependencies, dynamic environments, uncertainty, and sophisticated control play a notable role. Healthcare applications can take outstanding advantage of the intrinsic characteristics of multi-agent systems because of notable features that most healthcare applications share [8]:

- They are composed of loosely coupled (complex) systems.
- They are realized in terms of heterogeneous components and legacy systems.
- They dynamically manage distributed data and resources, and
- They are often accessed by remote users in (synchronous) collaboration.

JADE (Java Agent Development Framework) is a software framework implemented in Java language. Through a set of graphical tools, it simplifies the implementation of multi-agent systems. Multi-agent platforms designed by JADE can be distributed across machines, or using different operating systems. The architectural model of an agent-oriented application is intrinsically peer to peer, as any agent is able to initiate communication with any other agent or be the subject of an incoming communication at any time.

LITERATURE SURVEY

In a broader sense, the term of e-health characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology. The impact of e-health is as diverse as the health sector, improvement the quality of health-related content, the security of patient data, 'telemedicine' technologies, automating administrative processes for hospital staff, doctors and patients, and much more. There are many instances of successful e-health implementations including health information networks, Electronic Medical Records (EMR), telemedicine services, mobile monitoring systems, and health portals. Through

internet, the e-health care could point out record, measure, monitor, manage, and in the end to deliver patient oriented along with condition-specific care services in real time. Internet-based e-health is capable of operating ubiquitously, at anytime for anyone [9].

spectrum of domains: e-learning, work collaboration, knowledge management, manufacturing, network management, and supply-chain management. However, little research has been conducted on applying JADE framework to address issues in the field of e-health care. [9] Paper presents a unique approach of using JADE to develop a highly distributed information infrastructure that is able to perform ubiquitous electronic health monitoring automatically and autonomously for those who need it.

This [7] paper proposes an agent-based shopping system for electronic commerce. The aim of it is to automate shopping process by assisting customers to have commodity information retrieval and comparison in the massive information environment of the Internet. Based on the agent technology, the shopping system comprises multi-attribute evaluation model and preference evaluation model. The system consists of five types of agents that can interact with each other: *interface agent, buyer manager, buyer agent, evaluation agent and preference agent*. These agents collaborate with each other by the message delivery mechanism and make the whole system works together. The system framework has been built adopting the technology of the software reuse, thus promoting the reuse of each agent component.

In the [10] K4Care project (*Knowledge-Based Homecare eServices for an Ageing Europe*), this issue has been addressed. The main goal of the project is to develop an intelligent web platform for providing e-services to health professionals, patients and citizens involved with the care of elderly patients living at home.

In [2] paper consider new features of health care systems and identify some emerging technologies as enablers to deliver better quality care to citizens and more efficient service delivery to health professionals. They investigate a broader set of issues and a broader set of any solution based on the distributed agent technology than other health areas where this technology could be applied, particularly in cases where agents could be used to monitor activities and policies of various actors in the system.

Proposed Approach

In this paper we are mainly concentrating on the data flow within the e-health care organization. At first data comes to the organization from the outside world using internet. That data is the patient information who wants to checkup by the doctor. Patient can get the service from the system using the Patient Agent (PA). When the doctor wants to checkup the patient he/she can get all the detail of the patient and give the medicine using Doctor Agent (DA) and all the internal activity is control by Controller Agent (CA)

The agent is powerful, we are using the JADE agent building the user client and the server [4], when the agent is running the agent can autonomous get the environment information pass to the frame of user and server. For the JADE agent they have the follow advantages for we can use in this system [1]:

- **Autonomous:** The JADE agent can perform autonomously. Every agent have own executable thread. So that they can control own life-cycle at the time of performing some operation.
- **Peer-to-Peer:** Each agent identify by own global name, so that they can join and leave the system at any time of the operation of the system by requesting the controller. They also identify other performing agent with the help of white-page and yellow-page services.
- **Distributed System:** Every agent has separate thread for execution, so that they can run in different machines, different environment, and also can communication between them via internet.
- **Interaction Protocols:** Some of the protocol options already exist in the JADE library, when need just using the function, so implementation is very easy.
- **J2ME platform:** Support for J2ME platform and wireless environment. So it supports wide area of distributed computation.
- **Time requirement:** Using the agent concept the whole system makes very fast, means it becomes less time consuming.

Related Works

JADE is probably the most widespread agent-oriented framework in use today. It has been applying in a platform of projects and applications, both from the academic and the industrial communities. The applications cover wide

DESIGN

Architecture Diagram

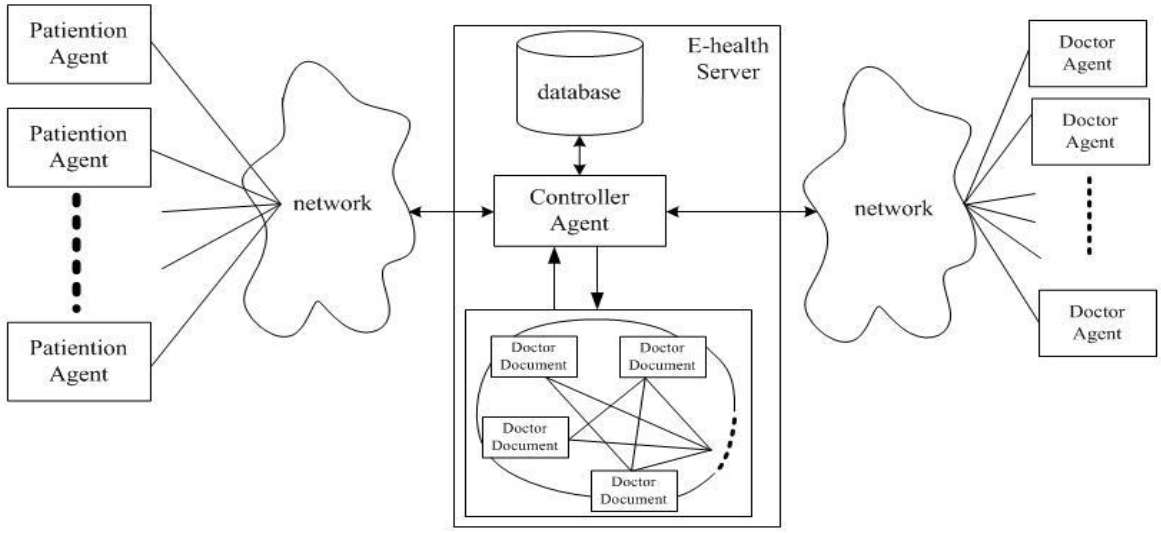

Fig. 1. Architecture Diagram of Agent Based e-Health Care Information System

Functional Specification

Within the specified network, the Patient Agent (PA), Doctor Agent (DA) and the Controller Agent (CA) are the primary active component.

- **Confidential Data:** All the patient information is highly confidential and private. It comes to the organization when the patient creates his/her account and when he/she wants to get appointment of the specific doctor. These data comes to the e-health care via internet and store into the database of the organization.
- **Internet:** It is the backbone of the whole system. Using this channel all the patient information is comes to the organization and after all operation data goes to the patient. It is fully unsecured channel and introducer can access the data for own benefit.
- **Fire well:** A firewall can protect a network from external attacks by examining all packets of a message attempting to pass through the network and rejecting the packets that do not meet the security restrictions.
- **Health Care Database:** It is collection of interrelated data that is used in the e-health care organization. That data can be easily store, update, maintain and delete using some set of query. So the data should be easily accessible by all the member of the organization when ever needed.
- **Shared Storage:** It is collection of interrelated data, i.e. doctor information, patient information, which is used at the time of patient select the specific doctor, patient put the query, doctor checkup the patient after seeing the whole detail of the patient, prescribed some medicine and if required then send the patient to another doctor. For all operation the data is stored in the shared storage like file.

- **Patient Agent (PA):** The Patient Agent (PA) is responsible to control all the operation which is carried out by the patient for the e-health care organization.

Receiving State:

- In this sate the Patient Agent (PA) accepts the patient information which comes from the internet.
- The Patient Agent (PA) determine which operation is required by the patient create an account or login his/her existing account. According the selection of the patient.

Process State:

- In this state Patient Agent (PA) perform all the operation of the patient.
- If patient want to create an account the after fill the from all the data is stored in the database of the organization
- If the patient wants to login his/her existing account the login window will be open. Then check given password matches with the user name or not. If matches then doctor select window will be open.
- Then patient can select the doctor after seeing the doctor details.
- When patient fill the credit card no and password for pay the money then password and account also checked by Patient Agent (PA) through Controller Agent (CA). If the password is correct and account balance is enough then only appointment process is over after reduce the balance from patient 'account.

Sending State:

- All the patient information is send to the specific doctor of the patient.

- Doctor can check the patient detail to prescribe some medicine.

- **Doctor Agent (DA):** The DA is responsible to control all the operation which is carried out by the patient's checkup for the e-health care organization.

Receiving State:
- Select the patient number from the list for checkup the patient.
- Get all the patient's information is from the file.

Process State:
- Get the patient information from the patient file.
- Diagnosed the patient detail according their query.
- Prescribed some medicine.
- If required then send the patient detail to another doctor for checkup.

Sending State:
- In this state all the patient information along with prescribed medicine is send to another doctor.
- Then control sent to the Controller Agent (CA)

- **Controller Agent (CA):** Controller Agent is mainly responsible to control all the operation which carried out by all Patient Agent (PA) and Doctor Agent (DA) for reduce the load of the server and process the job efficiently and quickly.

Receiving State:
- The entire request from patient first goes to the Patient Agent (PA) at the time of appointment to the specific doctor then it comes to the Controller Agent (CA).
- The entire request from doctor first goes to the Doctor Agent (DA) at the time of checkup the patient then it comes to the Controller Agent (CA).

Process State:
- At the time of patient appointment the patient login detail send to the Patient Agent (PA) after get it from the database to check the authenticity of the patient.
- At the time of patient appointment all the doctor detail send to the Patient Agent (PA) after get it from the database.
- After pay the money all patient case history is send to the specific doctor.
- Doctor gets patient information via the Controller Agent (CA) for Doctor Agent (DA).
- After prescribed the medicine, the entire data is store in the database.

Sending State:
- If required then sent the patient to another doctor along with all the detail and prescribed medicine.

Sequence Diagram

Sequence diagram describe the sequence of operation which is performs in the model by all the stack holder of the system. Using the sequence diagram we can clearly understand the operation of the entire component.

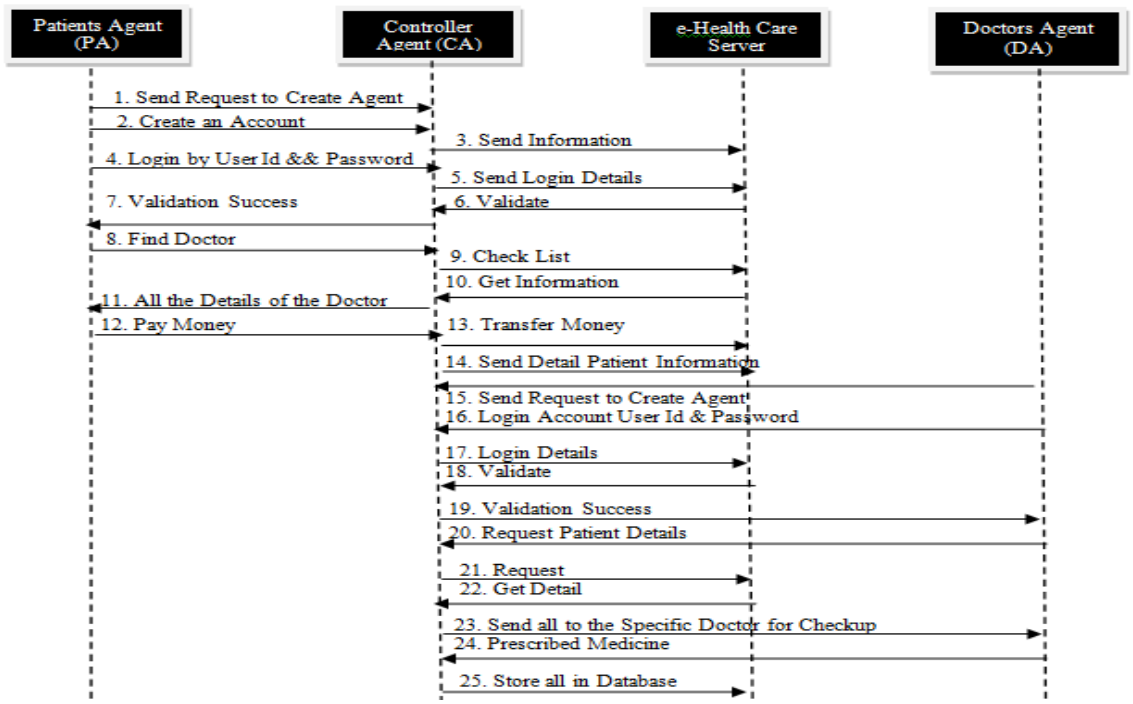

Fig. 2. Sequence Flow of Agent Based e-Health Care Information System

As illustrated in the Fig 2, following steps:

1. First patient have to create the Patient Agent (PA), so send the request to Controller Agent (CA).
2. Patient has to create an account first with all the detail information of his/her own. They provide a user id and password to access the account. The user id and password pair is unique for each patient.
3. Send all the information to e-health care server by Controller Agent (CA).
4. Using the user id and password patient login his/her account via Patient Agent (PA).
5. Controller Agent (CA) sends that to server.

6. Controller Agent (CA) validates the data.
7. Controller Agent (CA) validation success report to Patient Agent (PA). If success then only farter step will follow otherwise not.
8. Patient Agent (PA) finds the available doctor using the Controller Agent (CA).
9. Controller Agent (CA) checks the list of doctor from the database of the e-health care database.
10. Get the all information about the doctor profile from the server via Controller Agent (CA).
11. After get all the information Controller Agent (CA) send everything to Patient Agent (PA).
12. Then Patient Agent (PA) pays the money using his/her credit card.
13. Controller Agent (CA) checks all card name and corresponding password, and transfer money to server.
14. Controller Agent (CA) sends all the patient information to specific doctor file.
15. Then Doctor Agent (DA) sends the request to Controller Agent (CA) for creating an agent.
16. When Doctor Agent (DA) wants to checkup the patient. Doctor agent (DA) login his/her account using username and password by Controller Agent (CA).
17. Controller Agent (CA) send that data to server for validation.
18. Server validate if all the user id and password is correct.
19. Validation success report sends to the Doctor Agent (DA).
20. Doctor Agent (DA) requests for patient information to Controller Agent (CA).
21. Controller Agent (CA) put the request to server.
22. Controller Agent (CA) gets it from the data file for the specific Doctor Agent (DA).
23. Then all the details send to the doctor for checkup.
24. Doctor Agent (DA) gets all the patient information along it the patient query, so he/she can prescribe some medicine to the patient. And if required then sent the patient to another doctor via Controller Agent (CA).
25. After that Controller Agent store the entire case document to the data file of the organization.

DESIGN AND ANALYSIS

Design analysis includes the inputs, processes, and outputs of the active elements which are the Patient Agent (PA), Doctor Agent (DA) and Controller Agent (CA) s. All the activity of the system is controlled by Controller Agent (CA). Patient part activity is controlled by Patient Agent (PA) and doctor activity is controlled by Doctor Agent (DA).

Table I. Registration Form of Patient in Agent Based e-Health Care Information System

Sr. No.	*Data Field*	*Value Contain*
1	User Name	15 character
2	Password	20 character
3	Conform Password	20 character
4	First Name	50 character
5	Gender	15 character
6	Age	20 integer
7	Blood Group	5 character
8	Phone No	20 character
9	Email Id	70 character
10	Address	150 character

All the data should be given by the patient at the time of creating his/her account. The username is unique for each patient. So that at the time of creating an account every patient should be check the username is available or not. If available then only the next part of the form is valid. Using the user name the agent will be created.

Table II. Information Form of Doctor in Agent Based e-Health Care Information System

Sr. No.	*Data Field*	*Value Contain*
1	User Name	15 character
2	Password	20 character
3	Conform Password	20 character
4	First Name	50 character
5	Gender	15 character
6	Age	20 integer
7	Blood Group	5 character
8	Phone No	20 character
9	Email Id	70 character
10	Address	150 character

All the data of the doctor is stored in the database. Information should be given by the doctor to the e-health organization at beginning. Table II contains all the doctor information. Here doctor username and password also present. The username is unique for each doctor. Using that username Doctor Agent (DA) can call the Controller Agent at the time of checkup the patients.

Table III. Identification Form of Patient & Doctor in Agent Based e-Health Care Information System

Select	*Patient 1*	*Patient 2*	*Patient 3*	*Replay No*
Patient	100 character/ Location of File	100 character/ Location of File	100 character/ Location of File	3 character
Doctor	100 character/ Null	100 character/ Null	100 character/ Null	3 character

In the system all the patient as well as doctor information is stored in the user _information table. So we have to differentiate with theme. That is why in the table select column is present where we can select patient or doctor. At a time at most three patients can be communicate with doctor. We have to give the location of the file along with agent name where it stores before checkup for the specified doctor. Here replay no is present. For this system it is three character strings containing the value 0, 1 and 2. 0 means empty, 1 means the patient does not checkup and 2 means the checkup procedure is over. For the doctor no

need the location of storage because they get the patient detail and prescribed medicine which store in the doctor file.

Table IV. Credit Card Information of Agent Based e-Health Care Information System

Sr. No.	*Patient 1*	*Patient 2*	*Patient 3*	*Replay No*
1	15 character	20 character	50 character	floating point

All the credit card information is stored in credit_card table. At the time of pay the money to get appointment, card no and corresponding password is checked. If it is matched then only balance will redact from the account. Then new value will be shown to the patient. The operation is carried out by Controller Agent (CA) after getting the request from Patient Agent (PA). After pay the money the appointment process is over and patient information is send to specific doctor.

IMPLEMENTATION

At the time of implementation of Multi Agent Based Information System of a Small e-Health Care Using JADE Technology mainly Patient Agent (PA), Doctor Agent (DA) and Controller Agent (CA) we are consider. All the activity is carried out by these three agents.

1. The Agent Management System (AMS) is the agent that supervises the entire platform. It is the contact point for all agents that need to interact in order to access the white pages of the platform as well as to manage their life cycle. Every agent is required to register with the AMS (automatically carried out by JADE at agent start-up) in order to obtain a valid AID.
2. The Directory Facilitator (DF) is the agent that implements the yellow pages service, used by any agent wishing to register its services or search for other available services. The JADE DF also accepts subscriptions from agents that wish to be notified whenever a service registration or modification is made that match some specified criteria. Multiple DFs can be started concurrently in order to distribute the yellow pages service across several domains.

A JADE platform is composed of agent containers that can be distributed over the network. Agents live in containers which are the Java process that provides the JADE run-time and all the services needed for hosting and executing agents. There is a special container, called the *main container*, which represents the bootstrap point of a platform: it is the first container to be launched and all other containers must join to a main container by registering with it. As a bootstrap point, the main container has the following special responsibilities [6]:

- **Container Table (CT):** Managing the Container Table (CT), which is the registry of the object references and transport addresses of all container nodes composing the platform.
- **Global Agent Descriptor Table (GADT):** Managing the global agent descriptor table (GADT), this is the registry of all agents present in the platform, including their current status and location.
- **AMS and DF:** Hosting the AMS and the DF, the two special agents that provide the agent management and white page service, and the default yellow page service of the platform, respectively.

When the main-container is launched, two special agents are automatically instantiated and started by JADE, whose roles are defined by the FIPA Agent Management standard:

Figure 3 this GUI is actually provided by a JADE system agent called the Remote Monitoring Agent (RMA) and allows a platform administrator to manipulate and monitor the running platform. It should be noted that use of the RMA GUI, and all other graphical tools, can negatively impact system performance. This is one reason why the -GUI option is provided.

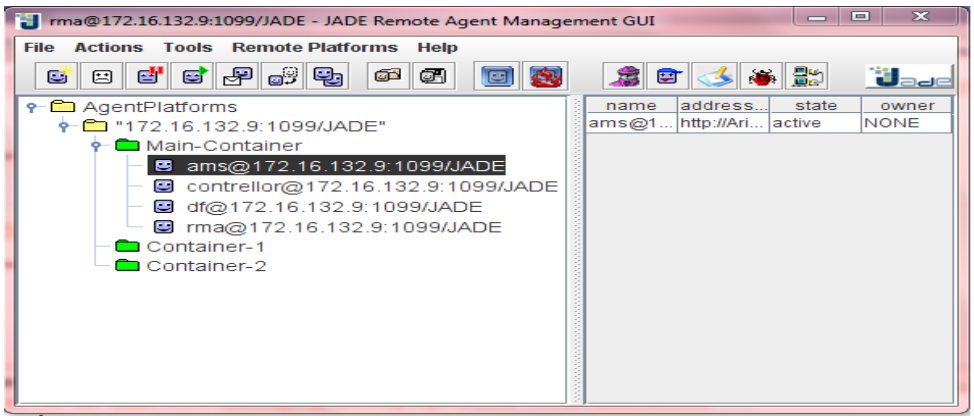

Fig. 3: GUI of the JADE RMA

Controller Agent

At first the controller agent is created. The controller agent is mainly responsible for controlling all the operation. It created by the server after creating the RMA GUI automatically. Patient as well as the doctor is selects here. If the user chooses the patient site then Patient Agent (PA) is call and the operation of the patient is carried out

one by one. If the doctor site is select then the Doctor Agent (DA) is called and then all the operation of doctor carried out one by one.

Patient Agent (PA)

Every Patient has to create own account. Figure 5 is the registration form. First check the availability of username. Username is unique for each patient. Using the username Patient Agent (PA) sends the request to create the agent window.

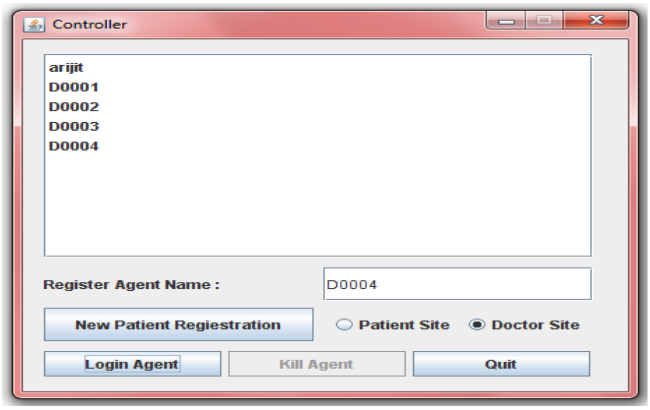

Fig. 4: Controller Agent (CA) of Agent Based e-Health Care Information System

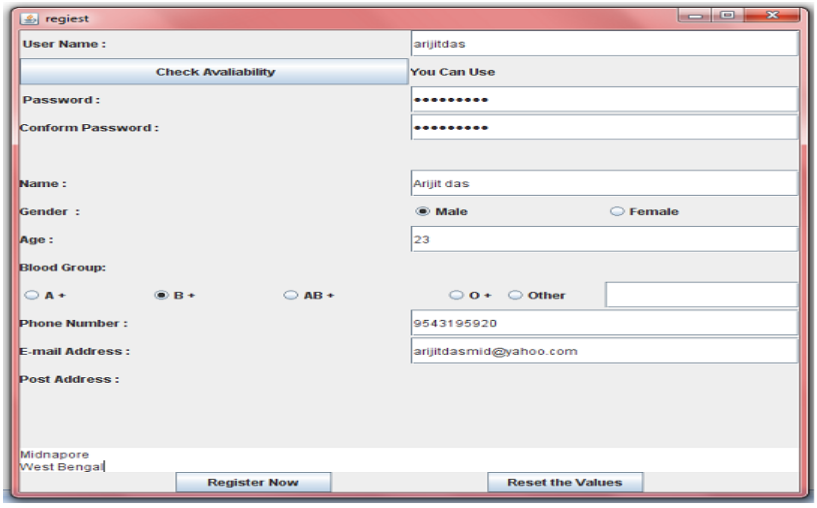

Fig. 5: Registration Form of Patient in Agent Based e-Health Care Information System

Patient Agent (PA) sends the request to Controller Agent (CA) to create the agent using the username of the patient. So the login window opens, where the patient can give his/her password. If the password is correct then only the Patient Agent (PA) is created for the patient. In the agent window the patient can select the specific doctor, put the query and give the credit card number & password. That card no and password is checked by Controller Agent (CA). If the credit card number and corresponding password is correct then only the doctor fees is reeducated from the account and the appointment procedure over. All the data of the patient is send to the specific doctor.

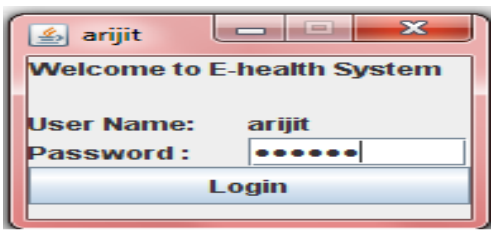

Fig 6. Patient Agent Login Window

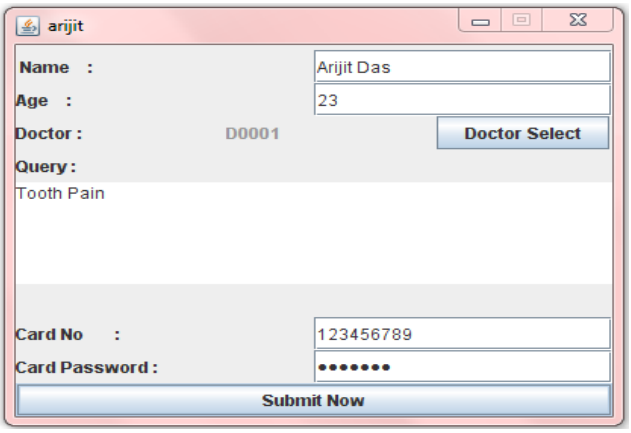

Fig. 7. Patient Agent Operation Window

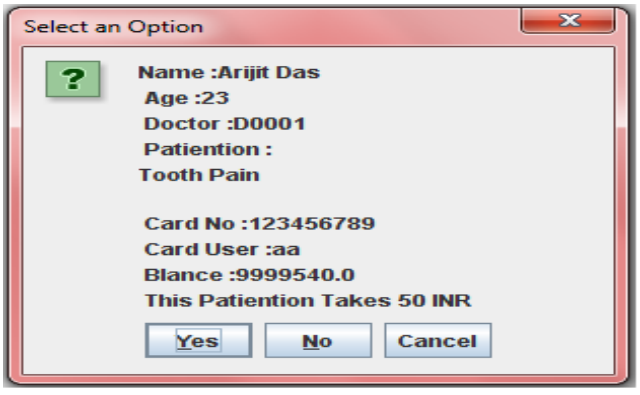

Fig. 8. Select Option Window of Patient Agent

Fig. 9. Patient Agent Message Window

Doctor Agent (DA)

Doctor Agent (DA) is responsible of all the operation which is performed by the doctor. At First every doctor has to create the agent. So he/she send the request to the Controller Agent (CA). After fill the username and password in the login window the agent is created. After successful login doctor can select the patient, after select patient all the patient information is displayed in the window to see that he/she can prescribe some medicine. If required then the doctor can send the patient to another doctor. That time this referred doctor can see the patient information, so he/she can prescribed some medicine as per requirement.

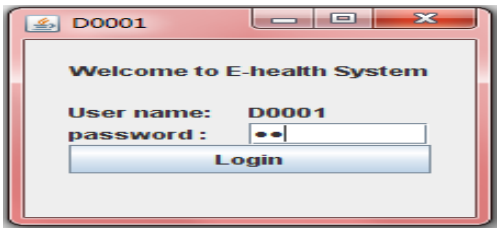

Fig. 10: Doctor Agent Login Window

At first Doctor Agent (DA) sends the request to Controller Agent (CA) to get the patient information. Figure 11 is the message window of the doctor. All the data which stored in the file of corresponding doctor is comes out from the doctor file. Figure 12 is the prescription window of the Doctor Agent (DA).

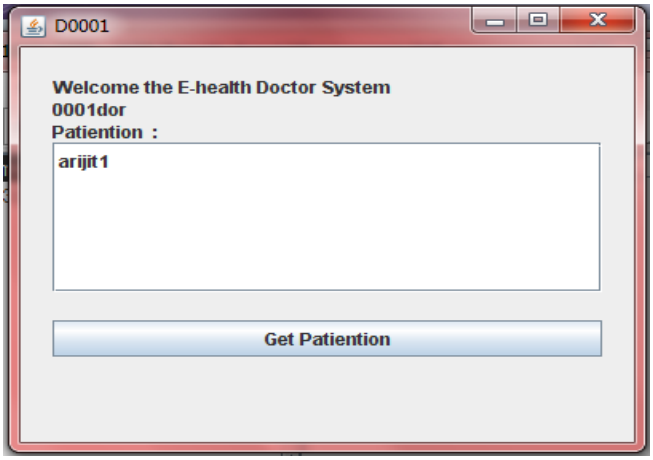

Fig. 11. Doctor Agent Get Patient Information

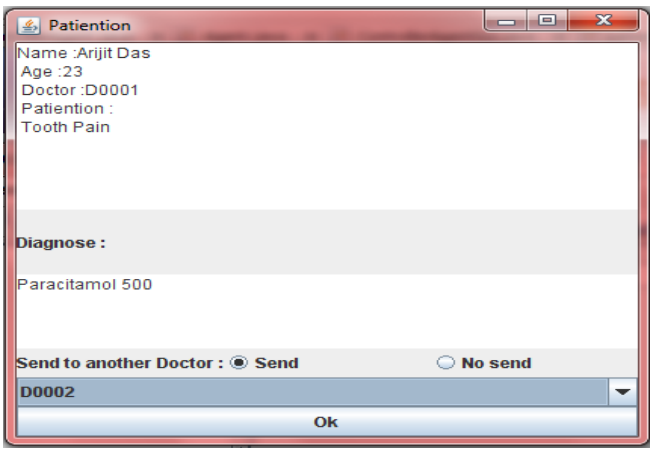

Fig. 12. Prescription Window of Doctor Agent Window

If the doctor wants to refer the patient to another doctor then send option is selected. And also appropriate doctor id will be selected. Otherwise if no need to refer the patient then no send option will be selected. The refer doctor can get the information after login his/her account and select the patient number. So he/she gets all the patient information as well as all the medicine which prescribed the previous doctor. After that refer doctor can prescribed medicine and if required then send the patient to another doctor.

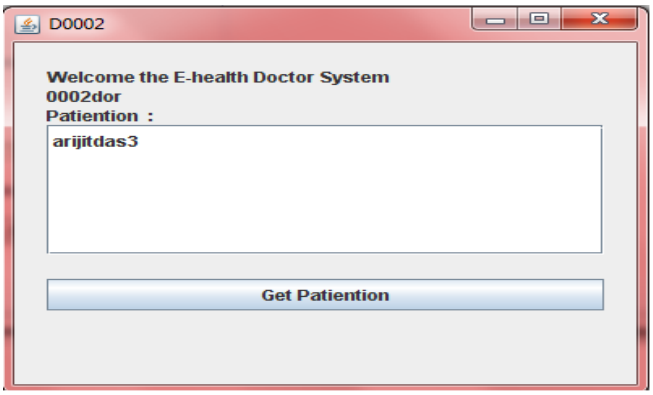

Fig. 13. Refer Doctor Patient Selection Window

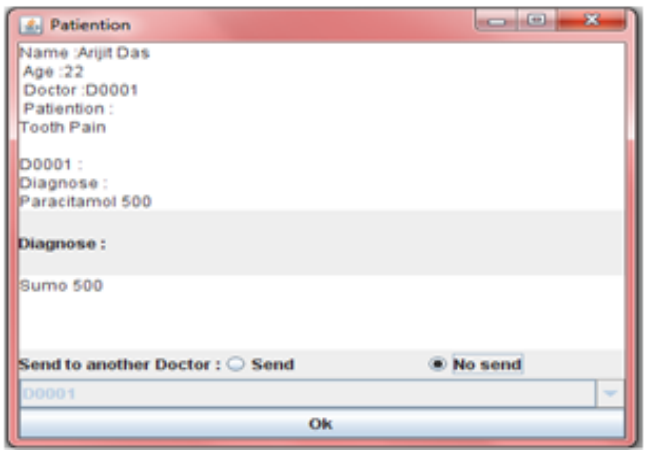

Fig. 14. Refer Doctor Prescription Window

To see all the patient information the doctor prescribed some medicine and all the medicine along with patient information is stored into the file of the doctor. After checkup all the data is stored in the system file and remove

from doctor file. This data can get by the patient after login his/her account.

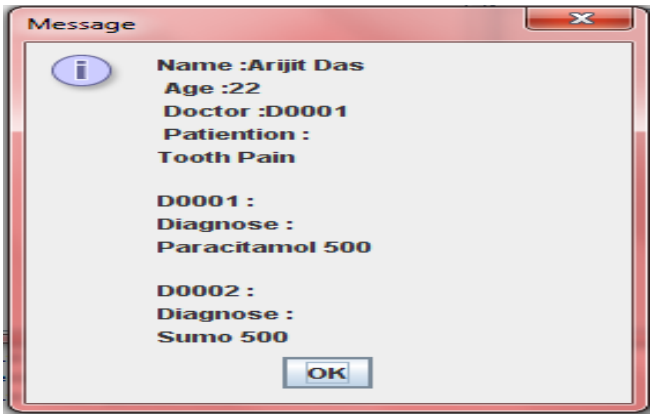

Fig 15. Prescription Window of the Patient

After see the data it goes to the backup file remove from system file. From that only manager of the system can retrieve the data. When manager want to send the data to the patient then only it collect from file and sent to the patient by the Controller Agent (CA) and data is removed from doctor file.

Message Passing

From proposed system design viewpoint, Figure 16 illustrates the system monitoring of e-health care. Figure represents message sequence for the connection between the Patient Agents (PA), Controller Agents (CA), and Doctor Agents (DA), using a series of requests through JADE agent ACL Messages.

See the message passing window which provided by the JADE we can easily understand the message flow of the entire agent within the system.

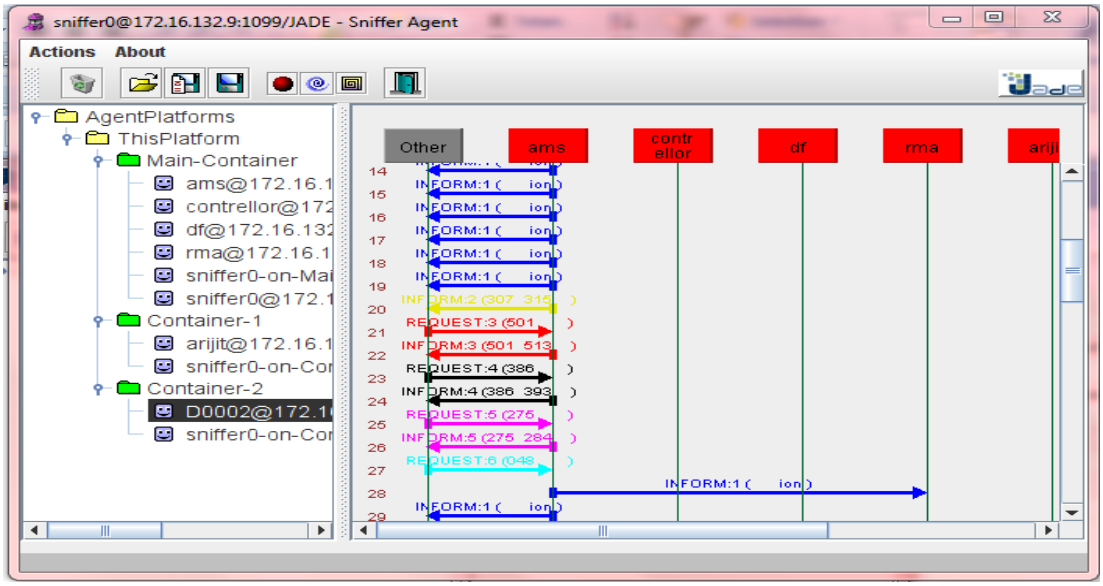

Fig. 16. Message Passing Window of Agent Based e-Health Care Information System

PERFORMANCE ANALYSIS

In previous work to develop a Information System Model of a Small e-Health Care Using Web Technology they did not use the agent technology. In our work we develop it for an e-health care using multi agent concept using JADE technology. To compare the performance of the both the system like previous one and developed system we first concentrate on the exestuation time.

Platform: Intel Core 2 Duo processor @ 2.1 GHz with Windows 7 using JAVA

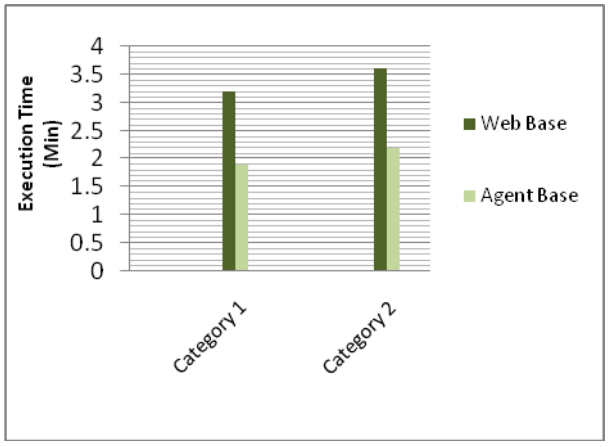

Fig. 17: Execution Time Comparison of Agent Based e-Health Care Information System

Here the two categories are, category 1 for patient without any refers doctor and category 2 for patient with refers doctor. The comparison between web base and agent based e-health care organization. From the above graph it is clear that using the agent technology the execution time is much less than web base.

CPU Utilization

Platform: Intel Core 2 Duo processor @ 2.1 GHz with Windows 7 using JAVA

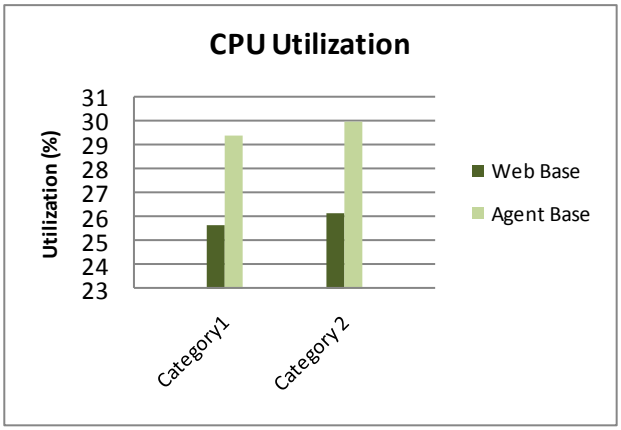

Fig. 18: CPU Utilization Comparison of Agent Based e-Health Care Information System

CONCLUSION AND FUTURE WORK

The objective of this research work was to design, implement a model which enhances internal functionalities of small e-health care organization. The data is stored in the database of the organization only patient and doctor can access the data. The model utilized multi agent concept using JADE technology, along with a database and file to store the data. All the operation is performed by Patient Agent (PA), Doctor Agent (DA) and Controller Agent (CA). The CA is the main responsible for controlling the whole operation. The operation is performed by agent that is way exestuation time very less. This model can be father implement using the intelligent agent concept. Where all the activity of the user is monitor and that data is used for increase the performance and decrease the exestuation time.

REFERENCES

[1] Zhang Yuheng and N.Ch.S.N. Iyengar, "Agent Based Architecture Media On Demand With Service Continuity", International Journal of Advances in Science and Technology, Vol. 2, No. 1, 2011, page 1-17

[2] CRISTINA TURCU, TUDOR CERLINCA, CORNEL TURCU, MARIUS CERLINCA, REMUS PRODAN, "An RFID and Multi-agent Based System for Improving Efficiency in Patient Identification and Monitoring", WSEAS TRANSACTIONS on INFORMATION SCIENCE and APPLICATIONS, ISSN: 1790-0832, Issue 11, Volume 6, November 2009
http://www.wseas.us/e-library/transactions/information/2009/29-796.pdf

[3] Minh Tuan Nguyen, Patrik Fuhrer, and Jacques Pasquier-Rocha, "Enhancing E-Health Information Systems with Agent Technology", International Journal of Telemedicine and Applications ,Volume 2009, Article ID 279091, 13 pages

[4]Marina V. Sokolova , Antonio Ferna´ndez-Caballero , "Modeling and implementing an agent-based environmental health impact decision support system", ScienceDirect Volume 36, Issue 2, Part 2, March 2009, Pages 2603-2614

[5] A. Daknou, H. Zgaya, S.Hammadi and H. Hubert, "Agent based optimization and management of healthcare processes at the emergency department", INTERNATIONAL JOURNAL OF MATHEMATICS AND COMPUTERS IN SIMULATION, Issue 3, Volume 2, 2008

[6] Developing multi-agent systems with JADE, WILY, page 30-50

[7] Zeng Zi-ming and Meng Bo, "An Intelligent Shopping System Based on Multi-agent Collaborative Working Model", IEEE CCECE/CCGEI, Saskatoon, page 1562 - 1565, May 2005

[8] Federico Bergenti, Agostino Poggi, "Multi-Agent Systems for e-Health: Recent Projects and Initiatives*",*
http://cmt.math.unipr.it/woa09/papers/Bergenti2.pdf

[9] Chuan-Jun Su, Chia-Ying Wu, "*JADE implemented mobile multi-agent based, distributed information platform for pervasive health care monitoring",*
http://ipac.kacst.edu.sa/eDoc/2009/173219_1.pdf

[10] Montserrat BATETa,1, Sergio MARTÍNEZa, Aïda VALLSa, and Karina GIBERTb, "Customization of an agent based medical System" ,
http://upcommons.upc.edu/e-prints/bitstream/2117/7982/1/customizationagnet.pdf

AUTHOR'S PROFILE

Arijit Das received B.Sc (Computer Science) degree from Midnapore College under Vidyasagar University, Midnapore, Paschim Medicipore, West Bengal, India. Currently he is a final year post graduate student of M.Sc (Computer Science) at VIT University, Vellore, Tamil Nadu, India. His areas of Interest are Cryptography, Network Security and Information Security.

Zhang Yuheng received B.Sc (Computer Science) degree from Central South University of Forestry and Technology, ChangSha , Hunan Province, China and also Vellore Institute of Technology University, T.N, India in 2009 under 3+1 top up programmer. Currently he is a final year graduate of M.Sc (Computer Science) at VIT University, Vellore, Tamil Nadu, India. His areas of Interest are Intelligent Distributed Computing and Cryptography and Network Security.

Sougata Khatua has received his B.Sc (Computer Science) degree from Midnapore College under Vidyasagar University**,** Paschim Medinipur, West Bengal, India. Currently he is a final year post graduate student of M.Sc (Computer Science) at VIT University, Vellore, Tamil Nadu, India. His areas of Interest are Cryptography and Information Security.

Dr. N.Ch.S.N. Iyengar (M.Sc, M.E, Ph.D) is a Senior Professor at the School of Computing Science and Engineering at VIT University, Vellore, Tamil Nadu, India. His research interests include Agent based Distributed Computing, Data Privacy and Security, Cryptography, Intelligent computational methods and Bio informatics. He has authored several textbooks and had nearly 100 research Publications in International Journals. He chaired many international conferences